

Application No. 10/717,839
Docket No. DP-310030
Amendment dated January 23, 2006
Reply to Office Action of September 22, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (Currently amended): A circuit board assembly comprising a laminate organic substrate having oppositely-disposed first and second surfaces, a surface-mount device attached with a plurality of solder bumps ~~at least one solder joint~~ to the first surface of the laminate organic substrate, and a localized stiffener attached with a plurality of solder bumps to the second surface of the laminate organic substrate directly opposite the device wherein the solder bumps space the localized stiffener from the laminate organic substrate to define a gap therebetween, the device and the localized stiffener having lateral dimensions in a plane parallel to the first and second surfaces of the laminate organic substrate with at least one of the lateral dimensions of the localized stiffener being greater than the lateral dimensions of the device, the laminate organic substrate, the device, and the localized stiffener having coefficients of thermal expansion and having moduli of elasticity, the coefficients of thermal expansion of the device and the localized stiffener being less than

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the coefficient of thermal expansion of the laminate organic substrate, the modulus of elasticity of the localized stiffener being greater than the modulus of elasticity of the laminate organic substrate, the localized stiffener being attached to the laminate organic substrate so as to locally stiffen the laminate organic substrate beneath the device and thereby increase the fatigue life of the at least one solder joint.

Claims 2 and 3 (Canceled)

Claim 4 (Currently amended): A circuit board assembly according to claim 1, ~~wherein the localized stiffener is attached to the second surface of the laminate substrate with a plurality of solder joints, the solder joints spacing the localized stiffener from the laminate organic substrate to define a gap, the circuit board assembly further comprising an underfill material that completely fills the gap between the localized stiffener and the laminate organic substrate.~~

Claim 5 (Original): A circuit board assembly according to claim 4, wherein the localized stiffener is a rejected surface-mount integrated circuit chip that is not electrically functional on the circuit board assembly.

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Claim 6 (Original): A circuit board assembly according to claim 1,
wherein the localized stiffener is entirely encapsulated with an adhesive.

Claim 7 (Original): A circuit board assembly according to claim 1,
wherein the localized stiffener is larger than the device.

Claim 8 (Original): A circuit board assembly according to claim 7,
wherein each of the lateral dimensions of the localized stiffener is greater than
the lateral dimensions of the device.

Claim 9 (Currently amended): A circuit board assembly according to
claim 1, wherein the localized stiffener has a cross-shape in a plane parallel to
the first and second surfaces of the laminate organic substrate.

Claim 10 (Original): A circuit board assembly according to claim 9,
wherein the cross-shape of the localized stiffener is defined by two pairs of
opposing legs that establish the lateral dimensions of the localized stiffener,
each pair of the opposing legs being parallel to one of the lateral dimensions of
the device, the lateral dimension established by each pair of the opposing legs
being greater than the lateral dimension of the device with which the pair of

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opposing legs is parallel.

Claim 11 (Original): A circuit board assembly according to claim 9, wherein the cross-shape of the localized stiffener is defined by two pairs of opposing legs that establish the lateral dimensions of the localized stiffener, each pair of the opposing legs being transverse to the lateral dimensions of the device and projecting beyond the lateral dimensions of the device.

Claim 12 (Original): A circuit board assembly according to claim 1, wherein the device and the localized stiffener having peripheral boundaries that establish the lateral dimensions of the device and the localized stiffener, the peripheral boundaries of the device being superimposed entirely within the peripheral boundaries of the localized stiffener.

Claim 13 (Currently amended): A circuit board assembly according to claim 1, wherein ~~the at least one solder joint comprises a plurality of solder joints that attach the device to the laminate substrate, the solder~~ bumps that attach the device to the first surface of the laminate organic substrate space ~~joints spacing~~ the device from the laminate organic substrate to define a gap, the circuit board assembly further comprising an underfill material that

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completely fills the gap between the device and the laminate organic substrate.

Claim 14 (Currently amended): A circuit board assembly comprising
a laminate organic substrate having oppositely-disposed first and second
surfaces, a surface-mount device attached with at least one solder joint to the
first surface of the laminate organic substrate, and a localized stiffener attached
to the second surface of the laminate organic substrate directly opposite the
device, the device and the localized stiffener having lateral dimensions in a
plane parallel to the first and second surfaces of the laminate organic substrate
with at least one of the lateral dimensions of the localized stiffener being greater
than the lateral dimensions of the device, the laminate organic substrate, the
device, and the localized stiffener having coefficients of thermal expansion and
having moduli of elasticity, the coefficients of thermal expansion of the device
and the localized stiffener being less than the coefficient of thermal expansion
of the laminate organic substrate, the modulus of elasticity of the localized
stiffener being greater than the modulus of elasticity of the laminate organic
substrate, the localized stiffener being attached to the laminate organic
substrate so as to locally stiffen the laminate organic substrate beneath the
device and thereby increase the fatigue life of the at least one solder joint,
according to claim 1, wherein the laminate organic substrate has conductive

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vias between the first and second surfaces that thermally couple the device to the localized stiffener.

Claim 15 (Currently amended): A circuit board assembly according to claim 1, wherein the localized stiffener has a modulus of elasticity of at least about ten times greater than the modulus of elasticity of the laminate organic substrate. ~~18 GPa.~~

Claim 16 (Original): A circuit board assembly according to claim 1, wherein the localized stiffener is formed of a material chosen from the group consisting of silicon, alumina, silicon nitride, silicon carbide, stainless steel, molybdenum, Fe-Ni alloys, and tungsten.

Claim 17 (Original): A circuit board assembly according to claim 1, wherein the circuit board assembly is an overmold circuit board assembly.

Claim 18 (Currently amended): A circuit board assembly comprising a laminate organic substrate having oppositely-disposed first and second surfaces, a surface-mount integrated circuit device attached with multiple solder bumps ~~joints~~ to the first surface of the laminate organic substrate, and a non-

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electrically functional stiffener attached with a plurality of solder bumps to a limited region of the second surface of the laminate organic substrate directly opposite the device wherein the plurality of solder bumps space the stiffener from the laminate organic substrate to define a gap therebetween that is completely filled with an underfill material, each of the device and the stiffener having peripheral boundaries that establish a pair of transverse dimensions in a plane parallel to the first and second surfaces of the laminate organic substrate, each of the transverse dimensions of the stiffener being greater than a corresponding one of the transverse dimensions of the device, the laminate organic substrate, the device, and the stiffener having coefficients of thermal expansion and having moduli of elasticity, the coefficients of thermal expansion of the device and the stiffener being less than the coefficient of thermal expansion of the laminate organic substrate, the modulus of elasticity of the stiffener being at least about ten times greater than the modulus of elasticity of the laminate organic substrate, ~~substrate and at least 18 GPa,~~ the stiffener being attached to the laminate organic substrate so as to locally increase the biaxial bending stiffness of the laminate organic substrate between the device and the stiffener and thereby increase the fatigue life of the solder bumps, the laminate organic substrate having conductive vias between the first and second surfaces that thermally couple the device to the stiffener. ~~joints.~~

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Claim 19 (Currently amended): A circuit board assembly according to claim 18, wherein the stiffener is entirely encapsulated with an adhesive. ~~the stiffener is attached to the second surface of the laminate substrate with an adhesive, at least one solder joint, or a combination thereof.~~

Claim 20 (Original): A circuit board assembly according to claim 19, wherein the stiffener is a rejected surface-mount integrated circuit chip.